National Transportation Safety Board
Aviation Incident Final Report

Location:	CHICAGO, IL	**Incident Number:**	CHI97IA117
Date & Time:	04/28/1997, 1300 CDT	**Registration:**	N9063U
Aircraft:	Boeing 737-200	**Aircraft Damage:**	Minor
Defining Event:		**Injuries:**	2 Minor, 56 None
Flight Conducted Under:	Part 121: Air Carrier - Scheduled		

Analysis

The airplane experienced an uncontained failure of the 10th stage compressor disk in the right engine. The flight crew aborted the takeoff, and an emergency evacuation was conducted after an engine fire was reported to the flight crew. Metallurgical inspection of the disk revealed that it had received insufficient nickel plating when it was reworked at the operator's facility 38 flight hours and 33 cycles prior to the incident. This resulted in cadmium embrittlement of the steel. The investigation revealed the operator had no written procedures to outline the process parameters and rectifier set-ups to be used during the NiCad plating process. NiCad plating line personnel also did not have any means of checking the thickness of the nickel plating during the plating process.

Probable Cause and Findings

The National Transportation Safety Board determines the probable cause(s) of this incident to be: inadequate nickel plating was applied to the compressor disk during the rework process at the operator's overhaul facility, which resulted in a brittle fracture in the disk and an uncontained engine failure. A factor was the operator's lack of written procedures and guidance for personnel on the NiCad plating line, along with their failure to supply a method of measuring the thickness of nickel applied.

Findings

Occurrence #1: LOSS OF ENGINE POWER(PARTIAL) - MECH FAILURE/MALF
Phase of Operation: TAKEOFF

Findings
1. (C) COMPRESSOR ASSEMBLY,ROTOR DISC - BRITTLE FRACTURE
2. (C) MAINTENANCE,REBUILD/REMANUFACTURE - IMPROPER - COMPANY MAINTENANCE PERSONNEL
3. (F) INADEQ SUBSTANTIATION PROCESS,INADEQ DOCUMENTATION - COMPANY/OPERATOR MGMT
4. (C) MISC,ENGINE UNCONTAINED FAILURE

Occurrence #2: FIRE
Phase of Operation: STANDING - ENGINE(S) OPERATING

Findings
5. ENGINE COMPARTMENT - FIRE

Factual Information

On April 28, 1997 at 1300 central daylight time (cdt), a Boeing 737, N9063U, operating as United flight 1210, sustained an uncontained engine failure on the right engine during takeoff from runway 32L, at the O'Hare International Airport, Chicago, Illinois. An emergency evacuation was ordered by the captain of the airplane, after reports of smoke and flames coming from the right engine. The 2 flight crewmembers, 2 cabin crewmembers, and 54 passengers evacuated the aircraft using the emergency slides. Two passengers sustained minor injuries in the evacuation, the remaining passengers and flight crew members were uninjured. The 14 CFR Part 121 flight was operating on an IFR flight plan, and visual meteorological conditions prevailed at the time of the incident.

The captain reported that the engine start and taxi were normal. He stated that after taxiing into position and hold no runway 32L he set the parking brake and the first officer took control of the airplane. He continued to report that upon reaching approximately 80% N1 and 20 knots of ground speed during the takeoff roll they heard a loud bang and the airplane yawed to the right. According to the captain, the first officer controlled the yaw and aborted the takeoff exiting the runway on the T-8 high speed taxiway. The captain notified the tower of the aborted takeoff. He reported that the only indication that the flightcrew had of a problem was the loss of rpm on the #2 engine. According to the captain the air traffic control tower reported seeing smoke and another airplane reported seeing fire. The captain then initiated engine fire and emergency evacuation procedures.

Following the incident the airplane was taken to the operator's maintenance facility where the right engine was removed from the airplane, and shipped to the operator's overhaul facility in San Francisco, California. During the removal of the engine a small piece of compressor disk was removed from the right side of the engine cowling. The runway area near where the uncontained engine failure occurred was searched and one additional piece of compressor disk was located that same evening. The two pieces of compressor disk were examined and a boroscope was used in an attempt to verify that all compressor disk portions had been found.

On May 5, 1997, disassembly of the engine, a Pratt & Whitney JT8D-7B s/n 655900, began at the operator's facility. Disassembly of the engine was unremarkable except for the tenth stage compressor disk. When the tenth stage compressor disk was removed the two pieces of compressor disk found at the incident site were matched with the remaining disk portion. This indicated that all significant portions of the tenth stage disk had been located. After the tenth stage disk was removed from the engine, all portions of the disk were sent to the National Transportation Safety Board's laboratory in Washington D.C. for further analysis.

The metallurgical analysis of the disk revealed that the disk was the correct hardness. The analysis also found that the disk was lacking nickel plating which is used during the rework process of the disk. The disk was found to have tool marks near the snap area which appeared to be a result of a machining operation.

Nickel is applied to the disk during normal rework operations followed by cadmium plating. The nickel is used to protect the steel from embrittlement by the cadmium plating.

The aircraft operator is certified to performs rework operations on this type of compressor disk at their overhaul facility in San Francisco. The failed disk had been overhauled at the operator's San Francisco facility in February 1997, 38 hours and 33 cycles prior to the failure.

The disk had a total of 25,060 hours and 16,195 cycles since new. As part of this investigation the aircraft operator located additional disks which had been reworked at their facility during February 1997. Some of the disks were found to have little or no nickel plating on them similar to the incident airplane's disk. Further investigation by the operator determined that during the period from February 5, 1997 until February 20, 1997 a discrepancy had occurred on the nickel cadmium line.

It was determined during the investigation that there were no written procedures to determine the process parameters and rectifier set-up procedures. In addition, personnel on the working on the NiCad plating line had no means with which to measure and record the thickness of the nickel plating prior to application of the cadmium. The operator has taken corrective action on these findings.

Pilot Information

Certificate:	Airline Transport; Commercial; Flight Engineer	**Age:**	46, Male
Airplane Rating(s):	Multi-engine Land; Single-engine Land	**Seat Occupied:**	Left
Other Aircraft Rating(s):	None	**Restraint Used:**	Seatbelt, Shoulder harness
Instrument Rating(s):	Airplane	**Second Pilot Present:**	Yes
Instructor Rating(s):	None	**Toxicology Performed:**	No
Medical Certification:	Class 1 Valid Medical--no waivers/lim.	**Last FAA Medical Exam:**	11/14/1996
Occupational Pilot:		**Last Flight Review or Equivalent:**	
Flight Time:	9537 hours (Total, all aircraft), 3128 hours (Total, this make and model)		

Aircraft and Owner/Operator Information

Aircraft Make:	Boeing	**Registration:**	N9063U
Model/Series:	737-200 737-200	**Aircraft Category:**	Airplane
Year of Manufacture:		**Amateur Built:**	No
Airworthiness Certificate:	Transport	**Serial Number:**	19944
Landing Gear Type:	Retractable - Tricycle	**Seats:**	116
Date/Type of Last Inspection:	Continuous Airworthiness	**Certified Max Gross Wt.:**	109000 lbs
Time Since Last Inspection:		**Engines:**	2 Turbo Fan
Airframe Total Time:		**Engine Manufacturer:**	P&W
ELT:	Not installed	**Engine Model/Series:**	JT8D-7B
Registered Owner:	UNITED AIRLINES	**Rated Power:**	14000 lbs
Operator:	UNITED AIRLINES	**Operating Certificate(s) Held:**	Flag carrier (121)

Meteorological Information and Flight Plan

Conditions at Accident Site:	Visual Conditions	**Condition of Light:**	Day
Observation Facility, Elevation:	ORD, 667 ft msl	**Distance from Accident Site:**	0 Nautical Miles
Observation Time:	1250 CDT	**Direction from Accident Site:**	0°
Lowest Cloud Condition:	Scattered / 4000 ft agl	**Visibility**	10 Miles
Lowest Ceiling:	None / 0 ft agl	**Visibility (RVR):**	0 ft
Wind Speed/Gusts:	Calm /	**Turbulence Type Forecast/Actual:**	/
Wind Direction:		**Turbulence Severity Forecast/Actual:**	/
Altimeter Setting:	29 inches Hg	**Temperature/Dew Point:**	16°C / 7°C
Precipitation and Obscuration:			
Departure Point:	(ORD)	**Type of Flight Plan Filed:**	IFR
Destination:	PHILADELPHIA, PA (PHL)	**Type of Clearance:**	IFR
Departure Time:	1300 CDT	**Type of Airspace:**	Class B

Airport Information

Airport:	CHICAGO OHARE (ORD)	**Runway Surface Type:**	Concrete
Airport Elevation:	667 ft	**Runway Surface Condition:**	Dry
Runway Used:	32L	**IFR Approach:**	None
Runway Length/Width:	13000 ft / 200 ft	**VFR Approach/Landing:**	None

Wreckage and Impact Information

Crew Injuries:	4 None	**Aircraft Damage:**	Minor
Passenger Injuries:	2 Minor, 52 None	**Aircraft Fire:**	On-Ground
Ground Injuries:	N/A	**Aircraft Explosion:**	None
Total Injuries:	2 Minor, 56 None	**Latitude, Longitude:**	

Administrative Information

Investigator In Charge (IIC):	DAVID A BOLDENOW	**Report Date:**	06/26/1998
Additional Participating Persons:	JEFFERY S BARNETT; SCHILLER PARK, IL		
Publish Date:			
Investigation Docket:	NTSB accident and incident dockets serve as permanent archival information for the NTSB's investigations. Dockets released prior to June 1, 2009 are publicly available from the NTSB's Record Management Division at pubinq@ntsb.gov, or at 800-877-6799. Dockets released after this date are available at http://dms.ntsb.gov/pubdms/.		